EXHIBIT A

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Etchegoyen

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(54) **PREDICTIVE DELIVERY OF INFORMATION BASED ON DEVICE HISTORY**

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(30) **Foreign Application Priority Data**

Jun. 7, 2013 (AU) 2013100804

(51) **Int. Cl.**

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H04W 4/14	(2009.01)
H04W 4/20	(2009.01)

(52) **U.S. Cl.**

CPC ***H04W 4/028*** (2013.01); *H04W 4/14* (2013.01); *H04W 4/206* (2013.01)

(58) **Field of Classification Search**

USPC 709/204, 217, 219, 223, 224

See application file for complete search history.

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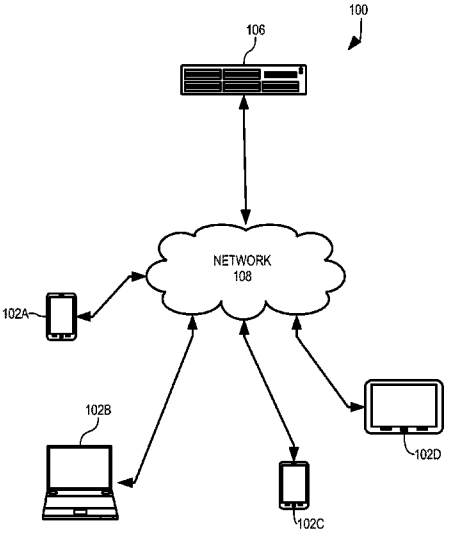
Primary Examiner — Viet Vu

(74) *Attorney, Agent, or Firm* — Sean D. Burdick

(57) **ABSTRACT**

A server sends information to user devices based on not only the current location of those devices but also predicted future locations of those devices. A number of actions are associated with one or more predetermined locations, a predetermined maximum amount of time, and a predetermined minimum likelihood. When the server determines that a given user device is likely to be in one of the predetermined locations within the predetermined maximum amount of time with at least the predetermined minimum likelihood, the server performs the associated acts with respect to the user device. An example of such an action is sending a promotion or advertisement to the user device, e.g., as an SMS message.

5 Claims, 6 Drawing Sheets



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WO	WO 2008/055865	5/2008

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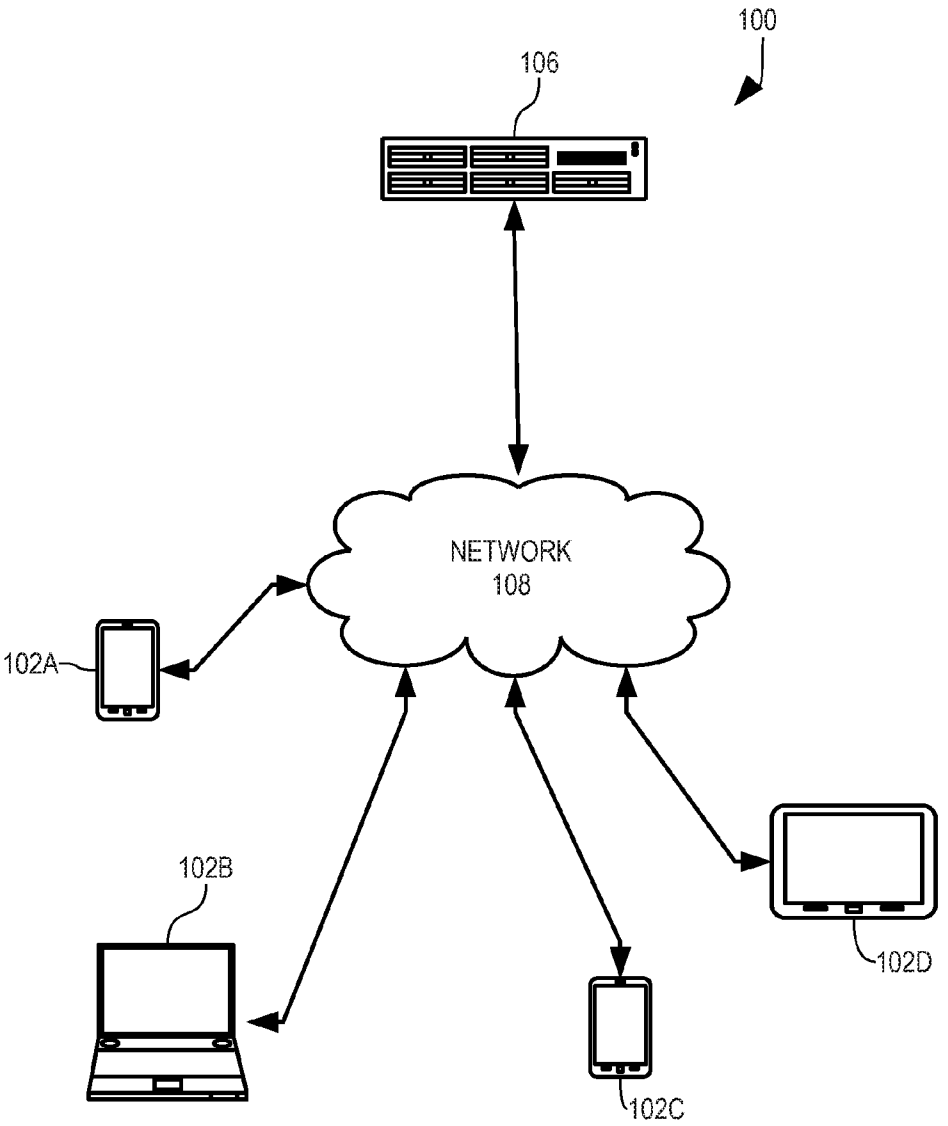

FIGURE 1

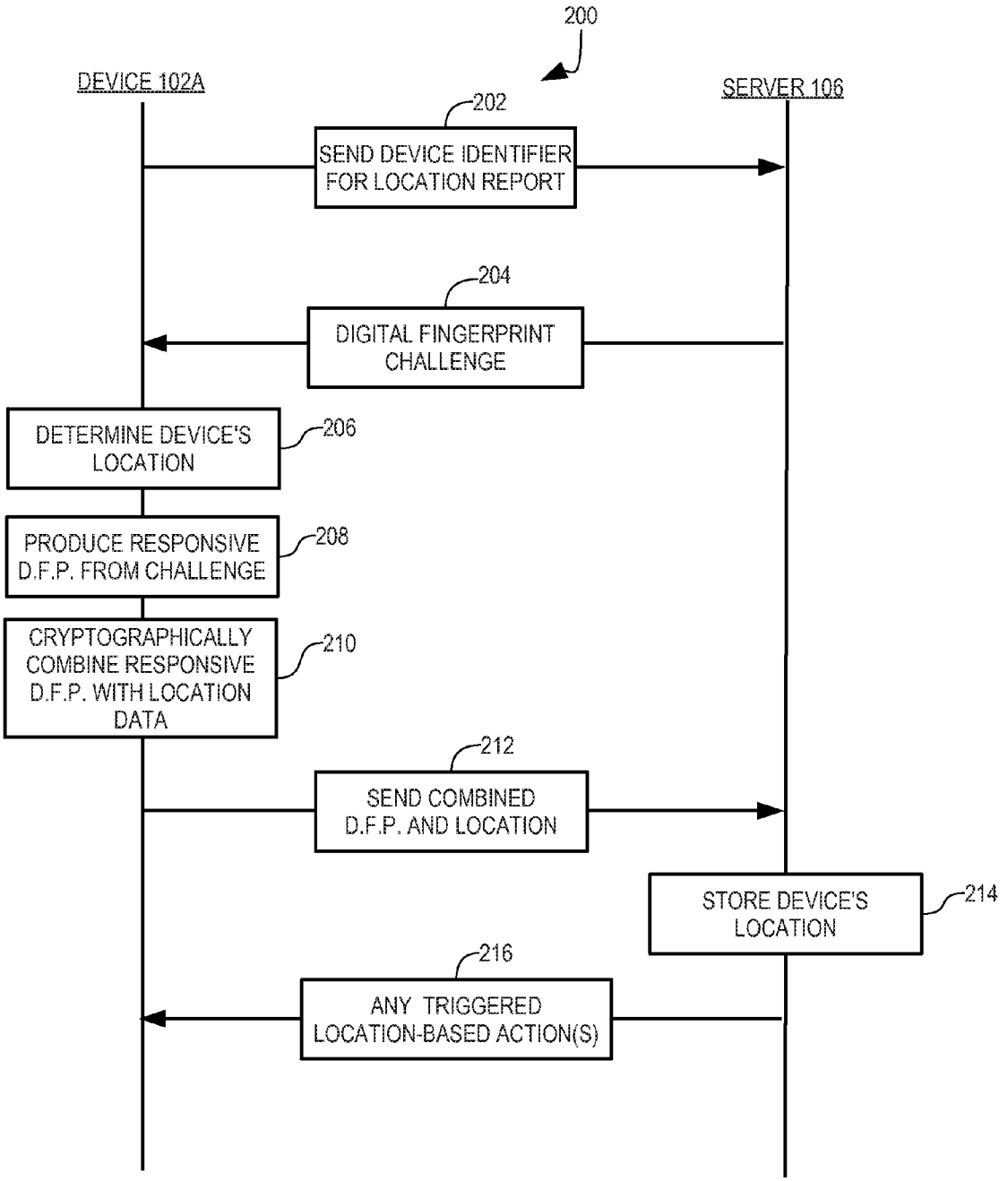
200
DEVICE 102A
SERVER 106
202
SEND DEVICE IDENTIFIER FOR LOCATION REPORT
204
DIGITAL FINGERPRINT CHALLENGE
DETERMINE DEVICE'S LOCATION
206
PRODUCE RESPONSIVE D.F.P. FROM CHALLENGE
208
CRYPTOGRAPHICALLY COMBINE RESPONSIVE D.F.P. WITH LOCATION DATA
210
212
SEND COMBINED D.F.P. AND LOCATION
STORE DEVICE'S LOCATION
214
216
ANY TRIGGERED LOCATION-BASED ACTION(S)

FIGURE 2

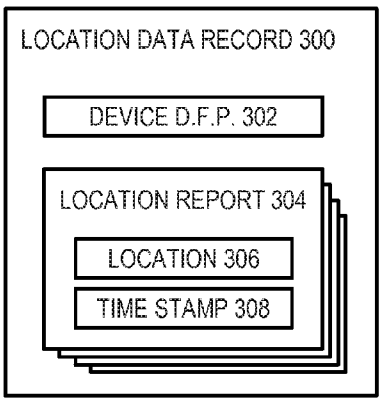

FIGURE 3

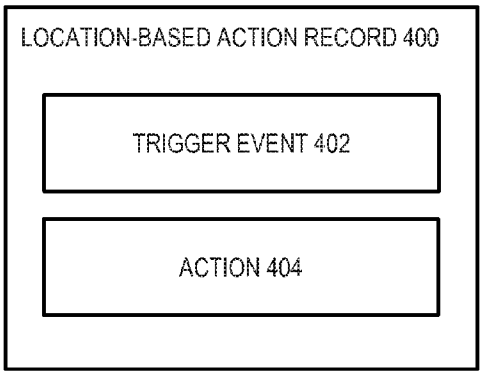

FIGURE 4

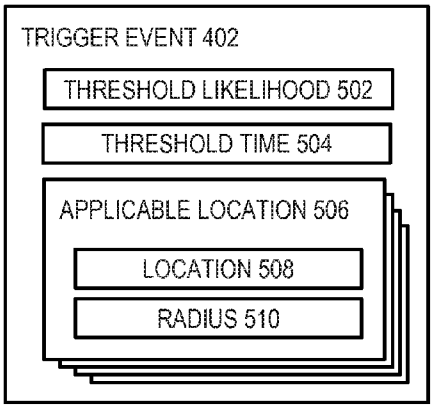

FIGURE 5

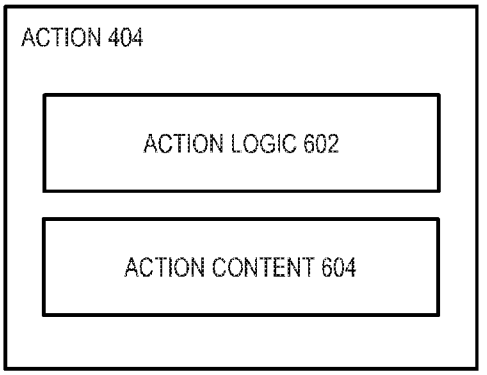

FIGURE 6

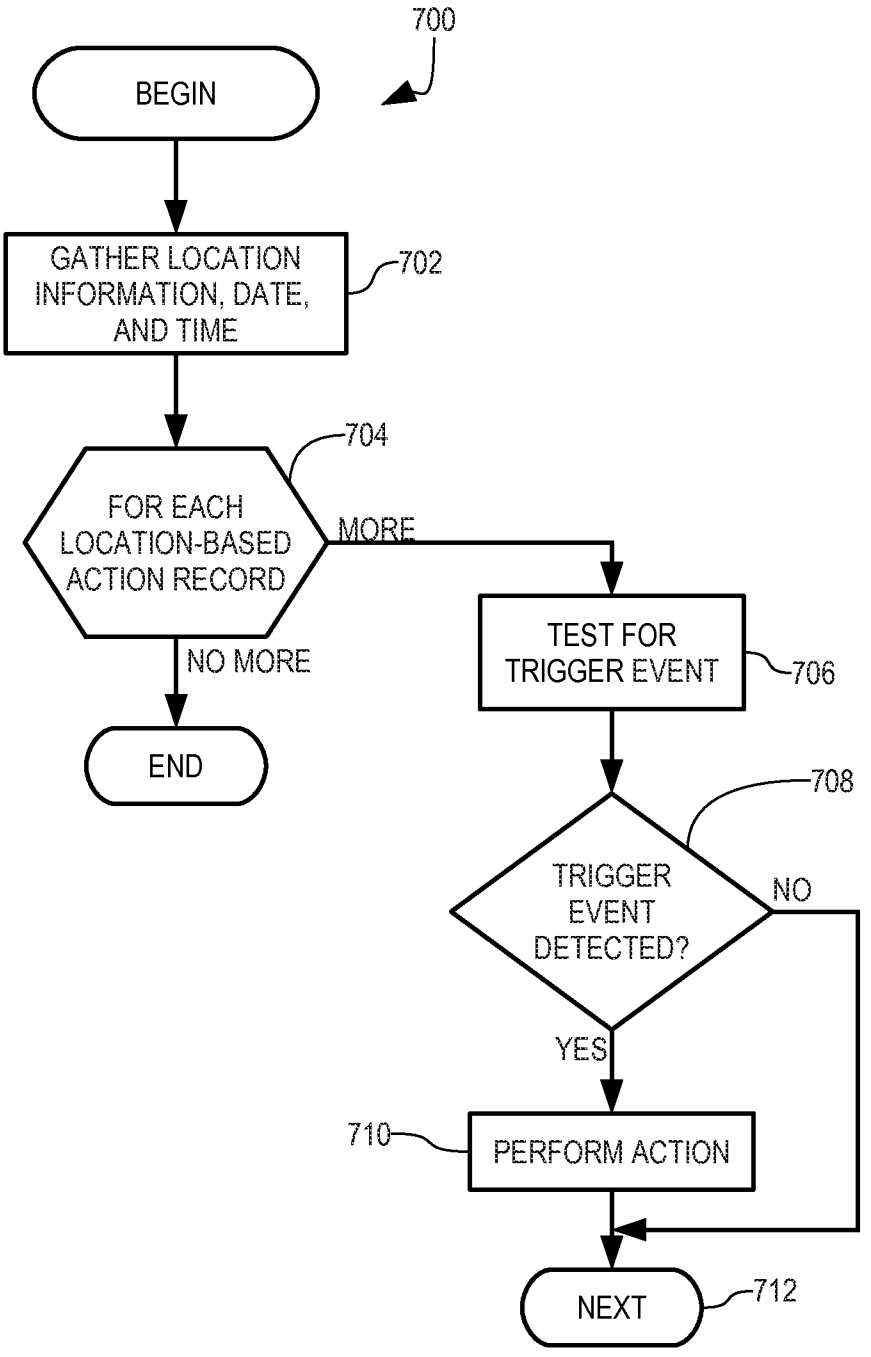
700
BEGIN
GATHER LOCATION INFORMATION, DATE, AND TIME
702
704
FOR EACH LOCATION-BASED ACTION RECORD
MORE
NO MORE
END
TEST FOR TRIGGER EVENT
706
708
TRIGGER EVENT DETECTED?
NO
YES
710
PERFORM ACTION
NEXT
712

FIGURE 7

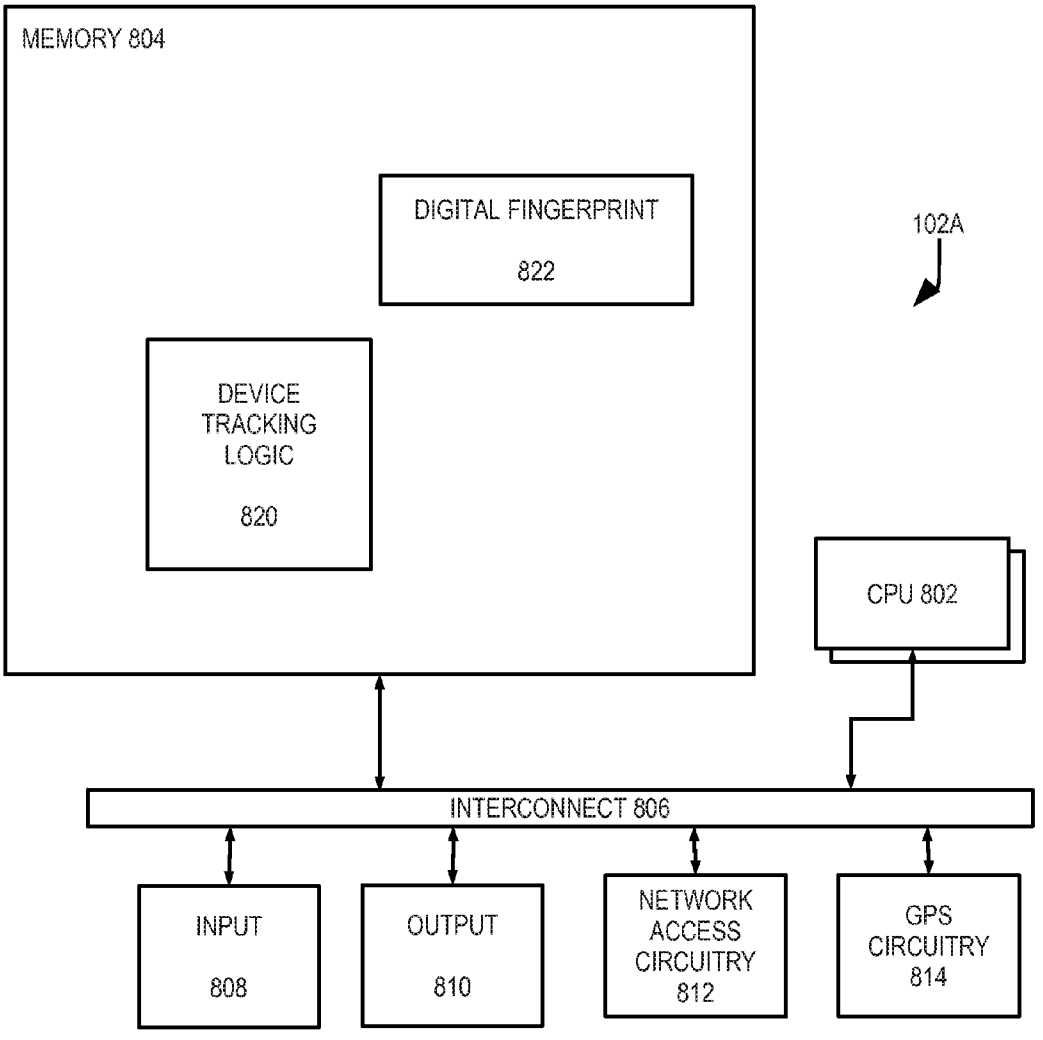
MEMORY 804
DIGITAL FINGERPRINT
822
102A
DEVICE
TRACKING
LOGIC
820
CPU 802
INTERCONNECT 806
INPUT
808
OUTPUT
810
NETWORK
ACCESS
CIRCUITRY
812
GPS
CIRCUITRY
814

FIGURE 8

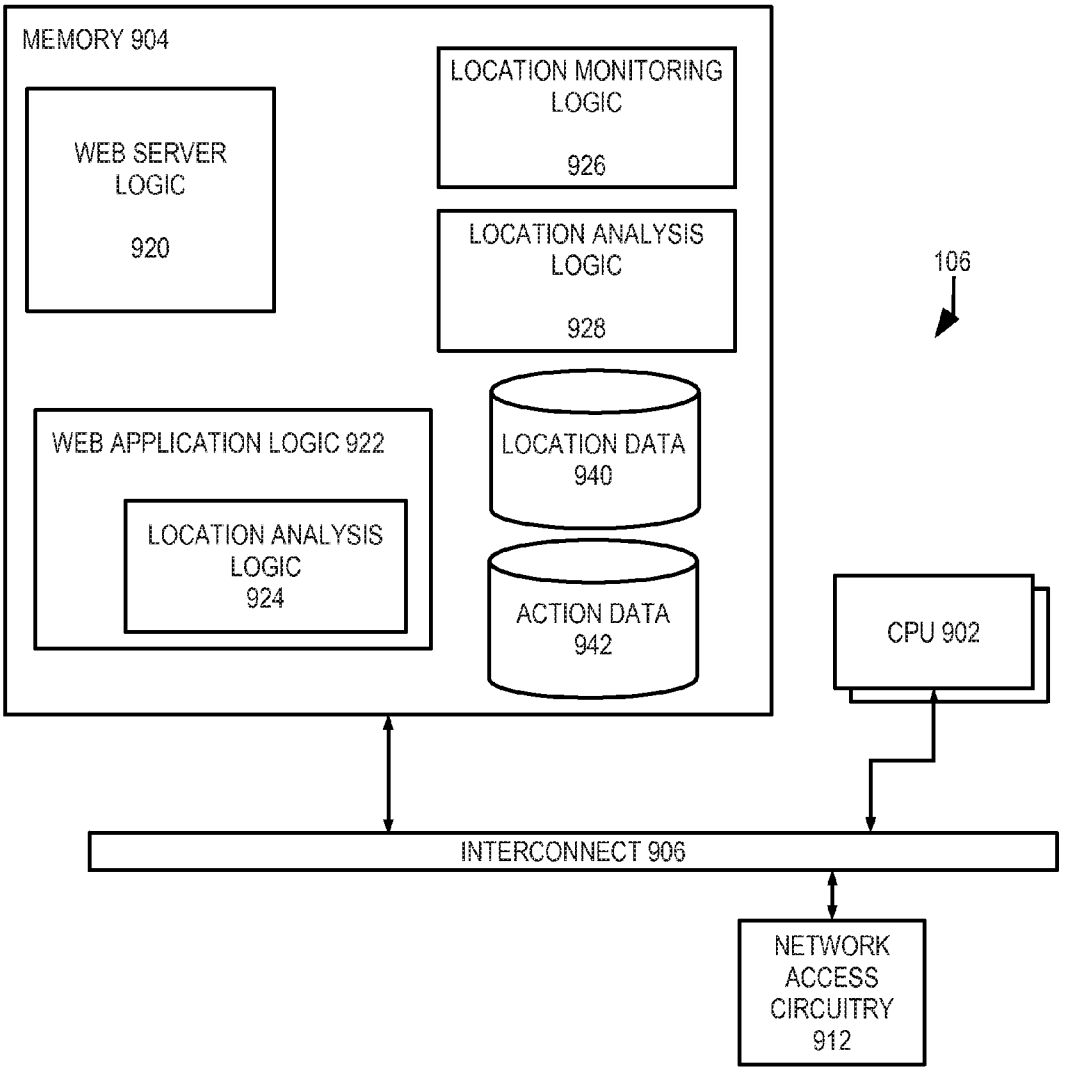
MEMORY 904
WEB SERVER LOGIC 920
LOCATION MONITORING LOGIC 926
LOCATION ANALYSIS LOGIC 928
WEB APPLICATION LOGIC 922
LOCATION ANALYSIS LOGIC 924
LOCATION DATA 940
ACTION DATA 942
106
CPU 902
INTERCONNECT 906
NETWORK ACCESS CIRCUITRY 912

FIGURE 9

PREDICTIVE DELIVERY OF INFORMATION BASED ON DEVICE HISTORY

This application claims priority to U.S. Provisional Application 61/774,305, filed Mar. 7, 2013, which is fully incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to computer data processing and, more particularly, methods of and systems for delivery of information to a device based on the location history of the device.

2. Description of the Related Art

Location-based services have been recognized as important and valuable for years. Typically, providers of location-based services arrange to have information regarding services delivered to device when the device is determined to be near a given location. However, the current location of a device provides very limited information about the device and therefore limits how relevant any location-based information sent to the device can be.

What is needed is a way to provide information to a device where the information is selected based on more than just the current location of the device.

SUMMARY OF THE INVENTION

In accordance with the present invention, a server sends information to user devices based on not only the current location of those devices but also predicted future locations of those devices. Over time, server gathers location information from the user devices to collect locations histories of the devices and uses the location histories to periodically predict future locations of the devices.

A number of actions are associated with one or more predetermined locations, a predetermined maximum amount of time, and a predetermined minimum likelihood. When the server determines that a given user device is likely to be in one of the predetermined locations within the predetermined maximum amount of time with at least the predetermined minimum likelihood, the server performs the associated acts with respect to the user device. An example of such an action is sending a promotion or advertisement to the user device, e.g., as an SMS message.

To make a prediction regarding future locations of the user device, the server considers the user device's location history in a current context. One part of the current context is the current day and the current time. To appreciate this context, it is helpful to consider an example. Consider that a new department store has opened at a given location. The manager of the department store can request that anyone that is at least 50% likely to visit a store considered to be in competition of the department store within one hour should be sent a promotional code entitling that person to a discount. To do so, the manager can specify locations of all competing stores within a five-mile radius of the given location as the one or more predetermined locations. In addition, the manager can specify 50% as the predetermined minimum likelihood and one hour as the predetermined maximum amount of time. The manager can also specify days and times at which the actions are applicable, e.g., only during hours at which the new department store is open.

Another part of the current context is the current location of the user device. Continuing in the example above, consider that a given user device has a history of shopping at the department store to get excellent customer service in learning about new products and then immediately going to a discount store to buy the new products at a lower price—the classic free rider problem. The presence of the user device in the department store can indicate that the user device will soon be heading to a competitor of the department store. Recognizing this, the server can deliver a promotional code to the user device, encouraging the user of the user device to buy the product in the department store rather than at the competitor.

In addition, if the manager of the department store sets up different actions for locations of competitors of a given type of store, the promotional code can be for a particular type of goods. Consider that all competitors selling electronics products are the predetermined locations. The action can be sending a promotional code for a discount on electronic products to the user device.

The current context can also be a combination of the current day and time and the current location of the user device. Continuing in the above example, consider that the department store includes a restaurant that does brisk business in the evenings but is nearly empty at lunch time on weekdays despite a flourishing business neighborhood in which many workers typically eat lunch at restaurants. The same manager can specify other nearby restaurants as the predetermined locations but limit the applicability of those locations to week days from 11:30 am to 2:00 pm, for example.

Unlike conventional location-based services in which information is presented to a user device based on its current location only, the information presented to a user device in the manner described herein can actually influence the future location of the user device by offering an alternative trip the user can take rather than the trip typically taken in the current context.

BRIEF DESCRIPTION OF THE DRAWINGS

Other systems, methods, features and advantages of the invention will be or will become apparent to one with skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features and advantages be included within this description, be within the scope of the invention, and be protected by the accompanying claims. Component parts shown in the drawings are not necessarily to scale, and may be exaggerated to better illustrate the important features of the invention. In the drawings, like reference numerals may designate like parts throughout the different views, wherein:

FIG. **1** is a diagram showing a server computer that gathers and analyzes location data from a number of mobile devices through a computer network to send information to a user device based on predicted future locations in accordance with one embodiment of the present invention.

FIG. **2** is a transaction flow diagram showing reporting of current location by a mobile device of FIG. **1**.

FIG. **3** is a block diagram of a location data record used by the server of FIG. **1** to represent a location report received from a mobile device.

FIG. **4** is a block diagram of a location-based action record used by the server of FIG. **1** to take actions based on predicted future locations of mobile devices.

FIG. **5** is a block diagram of a trigger event of the location-based action record of FIG. **4** in greater detail.

FIG. **6** is a block diagram of an action of the location-based action record of FIG. **4** in greater detail.

FIG. **7** is a logic flow diagram illustrating the manner in which the server of FIG. **1** processes location-based action records to take actions based on predicted future locations of mobile devices.

FIG. **8** is a block diagram showing a mobile device of FIG. **1** in greater detail.

FIG. **9** is a block diagram showing the server of FIG. **1** in greater detail.

DETAILED DESCRIPTION

In accordance with the present invention, a server **106** (FIG. **1**) sends information to user devices **102**A-D based on not only the current location of those devices but also predicted future locations of those devices. Over time, server **106** gathers location information from user devices **102**A-D and uses the gathered location information to periodically predict future locations of the devices.

User devices **102**A-D (FIG. **1**) each can be any of a number of types of networked computing devices, including smartphones, tablets, netbooks, laptop computers, and desktops computers, though location information is expected to be more useful for devices that are portable. Each of user devices **102**A-D serves as a location proxy for a single user. In other words, the location of each of user devices **102**A-D is presumed to be the location of a single user. In addition, each of user devices **102**A-D communicates with server **106** through a network **108**, which is the Internet in this illustrative embodiment. Network **108** can also be a mobile telephony network. User devices **102**A-D are analogous to one another and description of user device **102**A is equally applicable to user devices **102**B-D unless otherwise noted herein. It should also be noted that, while four (4) user devices are shown in this illustrative example, more or fewer than four (4) user devices can report locations for receiving future-location-based information in the manner described herein.

Transaction flow diagram **200** (FIG. **2**) illustrates the reporting by user device **102**A of its location to server **106**.

In step **202**, user device **102**A sends its globally unique device identifier to server **106** along with data indicating an intent to report the current location of user device **102**A.

In step **204**, server **106** sends a digital fingerprint challenge to user device **102**A. Digital fingerprints and digital fingerprint challenges are known and described in U.S. Patent Application Publication 2011/0093503 for "Computer Hardware Identity Tracking Using Characteristic Parameter-Derived Data" by Craig S. Etchegoyen (filed Apr. 21, 2011) and that description is incorporated herein in its entirety by reference.

Digital fingerprints offer the advantage of being more stable and less amenable to spoofing that are IP addresses and MAC addresses and, of particular significance here, require no user intervention. Accordingly, location reporting in transaction flow diagram **200** is secure, reliable (no device spoofing), and requires no action on the part of the user.

To avoid frequent communication of digital fingerprints through network **108**, device identification and authentication uses only part of the digital fingerprints of user devices **102**A-D. A digital fingerprint challenge specifies one or more parts of a digital fingerprint and a manner in which the parts are combined and cryptographically obscured. In addition, the digital fingerprint challenge can change each time device identification and authentication is needed. Accordingly, each time a given device sends its digital fingerprint in response to a different digital fingerprint challenge, the digital fingerprint sent is different. Any digital fingerprint intercepted within network **108** or any network will not authenticate properly if used in response to a different digital fingerprint challenge.

In step **206**, user device **102**A determines its geographic location. The manner in which user device **102**A determines its geographical location is described in U.S. Application 61/746,719, which was filed Dec. 31, 2012, and which is fully incorporated herein by reference.

In step **208**, user device **102**A produces a responsive digital fingerprint data using the challenge received in step **204** and digital fingerprint **822** (FIG. **8**).

In step **210** (FIG. **2**), user device **102**A cryptographically combines the responsive digital fingerprint data produced in step **208** with data representing the location of user device **102**A determined in step **208**. By cryptographically combining the responsive digital fingerprint data and the location data, user device **102**A makes the data tamper-evident and obscured.

In step **212**, user device **102**A sends the combined data to server **106**. In step **214**, server **106** parses the responsive digital fingerprint data and location data and stores the location of user device **102**A in location data **940** (FIG. **9**).

Server **106** stores the location of user device **102**A in a location data record **300** (FIG. **3**). Device digital fingerprint **302** is the digital fingerprint by which user device **102**A is identified and authenticated. A number of location reports **304** identify the location of user device **102**A at a given date and time. Location **306** represents the location of user device **102**A, and time stamp **308** represents the date and time.

In step **216** (FIG. **2**), server **106** sends information specified in any location-based actions stored by server that are triggered by the location history of user device **102**A. After step **216**, processing according to transaction logic diagram **200** completes.

Location-based actions specify actions to be taken if user device **102**A is predicted to be in any of a number of locations in the future within a predetermined amount of time by a predetermined threshold likelihood. An example of such a location-based action is represented by location-based action record **400** (FIG. **4**). Location-based action record **400** includes a trigger event **402** that represents the conditions under which action is to take place and an action **404** that is to take place under the conditions represented by trigger event **402**.

Trigger event **402** is shown in greater detail in FIG. **5**. In essence, trigger event **402** asks whether user device **102**A is likely to be in any of a number of locations within a predetermined amount of time in the future. Threshold likelihood **502** specifies a predetermined threshold likelihood. Threshold time **504** specifies a predetermined threshold amount of time into the future. Each of a number of application locations **506** specifies the locations. In this illustrative embodiment, each applicable location **506** is specified by a location **508** (such as latitude and longitude, for example) and a radius **510**. Thus, trigger event **402** specifies, as a condition for performance of action **404** (FIG. **4**), that user device **102**A must be determined to be at least as likely as threshold likelihood **502** (FIG. **5**) to be at any of applicable locations **506** within an amount of time represented by threshold time **504**.

Action **404** (FIG. **4**) is shown in greater detail in FIG. **6**. Action logic **602** specifies the behavior of server **106** in performing action **404**. For example, action logic **602** can cause server **106** to send an SMS or MMS message to user device **102**A or to register user device **102**A as one to receive a special discount if used to pay for a transaction at a merchant. Action content **604** specifies content to be used in performance of action logic **602**, e.g., the content to send to user device **102**A as a SMS or MMS message.

In some embodiments, location-based action record **400** can have multiple trigger events **402** combined with "AND" and/or "OR" relationships and/or multiple actions **404**.

The manner in which server **106** processes location-based action records such as location-based action record **400** is illustrated by logic flow diagram **700** (FIG. **7**). In step **702**, server **106** gathers the current location of user device **102**A and the current date and time.

Loop step **704** and next step **712** define a loop in which server **106** processes each of a number of location-based action records according to steps **706-710**. During each iteration of the loop of steps **704-712**, the particular location-based action record processed by server **106** is sometimes referred to as "the subject location-based action record."

In step **706**, server **106** determines whether the subject location-based action record is currently triggered. There are generally two (2) predictive patterns checked by server **106** in determining the likelihood of user device **102**A to be in a particular place at a particular time. The first is by analyzing the location data record **300** (FIG. **3**) for user device **102**A for location patterns associated with times of day, days of the week, days of the month, and days of the year. For example, the user of user device **102**A might have lunch at the same place at least three (3) days each work week—typically at about 12:30 pm. If the current time is 12:00 pm and it is currently a work week day, server **106** can determine that the likelihood of user device **102**A going to that same place within the next hour to be three in five, or 60%. Server **106** can also take into account other information such as whether user device **102**A has not gone to that same place in the previous two (2) days of the current work week.

The second is by analyzing the location data record **300** (FIG. **3**) for user device **102**A for location patterns associated with other locations of user device **102**A. In other words, server **106** tries to answer the question, "Given that user device **102**A is at its current location, what are the odds that user device **102**A will be in another given location within the predetermined amount of time according to the location history of user device **102**A?" For example, a user may have the tendency to shop in a large department store to get help from sales clerks and then go around the corner to a discount shop to buy merchandise at a great discount. The presence of user device **102**A in the large department store can indicate that user device **102**A is likely to be in the discount shop in the near future.

Server **106** can identify such a tendency by identifying each location report **304** (FIG. **3**) representing a location of user device **102**A within a predetermined distance of its current location and determining how many of those location reports **304** are followed within the predetermined amount of time of threshold time **504** (FIG. **5**) of a location report **304** (FIG. **3**) of user device **102**A at one or more of applicable locations **506** (FIG. **5**).

Server **106** can also combine the current time and the current location of user device **102**A in testing trigger event **402**. For example, server **106** can consider only location reports **304** (FIG. **3**) that are near the current location of user device **102**A and that have time stamps **308** that are between the current time and the future time represented by threshold time **504** (FIG. **5**) for relevant days of the week, month, year, etc. Considering only those location reports **304** (FIG. **3**), server **106** can determine how frequently user device **102**A visits an applicable location **506** after being at its current location.

It is helpful to consider the example of a trigger event **402** (FIG. **5**) in which threshold likelihood **502** represents 70%, threshold time **504** represents one hour, and applicable locations **506** represent various locations of a retail business. This trigger can be satisfied (i) if user device **102**A goes to the retail business in a predictable pattern, such as every Friday evening at around 6:30 pm and it's currently 5:45 pm, of (ii) if user device **102**A typically visits a competitor retail business before visiting the subject retail business and user device **102**A is currently at the competitor retail business.

In test step **708** (FIG. **7**), server **106** determines whether the trigger event of the subject location-based action record is satisfied. If so, processing transfers to step **710** in which server **106** performs the action of the subject location-based action record. If not, server **106** skips step **710**.

After steps **708-710**, processing by server **106** transfers through next step **712** to loop step **704** and server **106** processes the next location-based action record according to the loop of steps **704-712**. When all location-based action records have been processed according to the loop of steps **704-712**, processing according to logic flow diagram **700** completes.

In one embodiment, user device **102**A is configured to report its location according to transaction logic diagram **200** at regular time intervals. In an alternative embodiment, user device **102**A is configured to report its location according to transaction logic diagram **200** in response to a number of triggering events, including for example, determination of the location of user device **102**A for reasons independent of reporting of the location to server **106** and connecting to a wireless networking access point. Thus, any time the user of user device **102**A uses GPS circuitry of user device **102**A resulting in determination of the location of user device **102**A, user device **102**A reports the location to server **106** in the manner described above.

User device **102**A is a personal computing device and is shown in greater detail in FIG. **8**. User device **102**A includes one or more microprocessors **802** (collectively referred to as CPU **802**) that retrieve data and/or instructions from memory **804** and execute retrieved instructions in a conventional manner. Memory **804** can include generally any computer-readable medium including, for example, persistent memory such as magnetic and/or optical disks, ROM, and PROM and volatile memory such as RAM.

CPU **802** and memory **804** are connected to one another through a conventional interconnect **806**, which is a bus in this illustrative embodiment and which connects CPU **802** and memory **804** to one or more input devices **808**, output devices **810**, and network access circuitry **812**. Input devices **808** can include, for example, a keyboard, a keypad, a touch-sensitive screen, a mouse, a microphone, and one or more cameras. Output devices **310** can include, for example, a display—such as a liquid crystal display (LCD)—and one or more loudspeakers. Network access circuitry **812** sends and receives data through computer networks such as network **108** (FIG. **1**). GPS circuitry **814** determines the location of user device **102**A in a conventional manner.

A number of components of user device **102**A are stored in memory **804**. In particular, device tracking logic **820** is all or part of one or more computer processes executing within CPU **802** from memory **804** in this illustrative embodiment but can also be implemented using digital logic circuitry. As used herein, "logic" refers to (i) logic implemented as computer instructions and/or data within one or more computer processes and/or (ii) logic implemented in electronic circuitry. Device tracking logic **820** causes user device **102**A to report its location in the manner described above.

Digital fingerprint **822** is persistent data stored in memory **804**.

Server **106** is a computing device and is shown in greater detail in FIG. **9**. Server **106** includes one or more micropro-

cessors **902** (collectively referred to as CPU **902**), memory **904**, an interconnect **906**, and network access circuitry **912** that are analogous to CPU **802** (FIG. **8**), memory **804**, interconnect **806**, and network access circuitry **812**, respectively.

A number of components of server **106** are stored in memory **904**. In particular, web server logic **920** and web application logic **922**, including location analysis logic **924**, are each all or part of one or more computer processes executing within CPU **902** from memory **904** in this illustrative embodiment but can also be implemented using digital logic circuitry. Location monitoring logic **926** and location analysis logic **928** are also each all or part of one or more computer processes executing within CPU **902** from memory **904** in this illustrative embodiment but can also be implemented using digital logic circuitry.

Web server logic **920** is a conventional web server. Web application logic **922** is content that defines one or more pages of a web site and is served by web server logic **920** to user devices such as user device **102**A. Location analysis logic **924** specifies the behavior of server **106** in providing location analysis services in the manner described above. For example, location analysis logic **924** determines the likelihood that user device **102**A will be in a particular location within a predetermined amount of time. In addition, location analysis logic **924** analyzes location data **940**, invoking location analysis logic **928** in some embodiments.

Location monitoring logic **926** specifies the behavior of server **106** in receiving location reports in the manner described above and in the UN-003 Application. Location analysis logic **928** specifies the behavior of server **106** in analyzing location data **940** in the manner described herein and in the UN-003 Application.

Location data **940** and action data **942** are each data persistently stored in memory **904** and are each organized as one or more databases in this illustrative embodiment. Location data **940** includes location data records such as location data record **300** (FIG. **3**). Action data **942** includes location-based action records such as location-based action record **400** (FIG. **4**).

The above description is illustrative only and is not limiting. The present invention is defined solely by the claims which follow and their full range of equivalents. It is intended that the following appended claims be interpreted as including all such alterations, modifications, permutations, and substitute equivalents as fall within the true spirit and scope of the present invention.

What is claimed is:

1. A method for delivering information to two or more user devices, the method comprising:

retrieving the information from one or more data records that associate the information with one or more predetermined locations, a predetermined maximum amount of time, a predetermined likelihood, and one or more predetermined actions; and

for each of the two or more user devices:

predicting whether the user device will be at any of the one or more predetermined locations within the predetermined maximum amount of time with at least the predetermined likelihood; and

in response to the predicting that the user device will be at any of the one or more predetermined locations within the predetermined maximum amount of time with at least the predetermined likelihood, performing the one or more predetermined actions;

wherein at least one of the actions includes delivering the information to the user device.

2. The method of claim **1** wherein predicting comprises:

analyzing a location history of the user device.

3. The method of claim **1** wherein predicting comprises:

analyzing a location history of the user device for day- and time-based patterns related to a current time and a current day.

4. The method of claim **1** wherein predicting comprises:

analyzing a location history of the user device for movement patterns related to a current location of the user device.

5. The method of claim **1** further comprising:

analyzing a location history of the user device for patterns that involve day- and time-based and movement related to a current time, a current day, and a current location of the user device.

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